RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK7327

RELIABLE SUBMINIATURE DOUBLE TRIODE

The CK 7327 is a heater-cathode type double triode of sub-miniature construction designed for pulse application only. The CK 7327 is a direct replacement for types 6111 and 6021 in pulse applications. This type is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-pin sub-miniature socket may be used by cutting the leads to a suitable length.

MECHANICAL RATINGS: (Absolute Ratings)

Impact Acceleration .... 735 G
Fatigue (Vibrational Acceleration for Extended Periods) .... 10 G
Bulb Temperature .... 150 °C
Altitude .... 80,000 Ft.

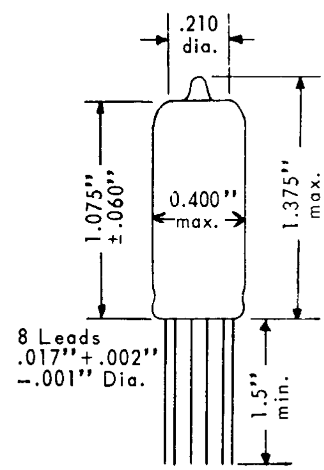
ELECTRICAL DATA

Ratings and Normal Operations	MIL-E-1 Symbol	Test Limit or Absol. Min.	Norm. Test Cond.	Normal Operation	Test Limit or Absol. Max.	MIL-E-1 Units
			RATINGS			
Heater Voltage	Ef	5.7	6.3	---	6.9	V
Plate Voltage (Average)	Eb	---	---	---	250	Vdc
Peak Plate to Cathode Voltage (Note D)	eb	---	---	---	300	v
Plate Dissipation (per plate)	Pp/p	---	---	---	0.95	Watts
DC Grid Voltage	Ec	−55	---	---	0	Vdc
Grid Dissipation (per grid)	Pg/g	---	---	---	0.2	Watts
Peak Tube Drop	etd	---	---	---	150	v
Forward Plate Voltage (Instantaneous) Note A	epy	---	---	---	400	v
Instantaneous Grid Cathode Voltage	egk	−100	---	---	80	v
Heater Cathode Voltage	Ehk	---	---	---	±200	v
Grid Circuit Res.	Rg1	---	---	---	1.1	meg.
			TESTS			
Heater Current	If:	280	---	300	320	mA
Heater-Cathode Leakage Ehk=±100Vdc Note B	Ihk:	---	---	---	5.0	μAdc
Plate Current Eb=300 Vdc; Rk=0 Ec=−32Vdc; (Note B)	Ib:	---	---	---	10	μAdc

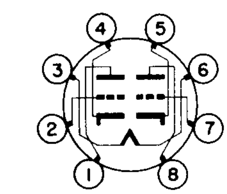
MECHANICAL DATA

ENVELOPE .... Glass T-3
OUTLINE .... JEDEC (3-1)
BASE .... E8-10 Submin., Button Flexible Leads
BASING 8DG
CATHODE ..... Coated Unipotential
MOUNTING POSITION .... Any

PHYSICAL DIMENSIONS



BASING



TERMINAL CONNECTIONS:

Lead 1 Plate, Unit #2
Lead 2 Grid, Unit #2
Lead 3 Heater
Lead 4 Cathode, Unit #2
Lead 5 Cathode, Unit #1
Lead 6 Heater
Lead 7 Grid, Unit #1
Lead 8 Plate, Unit #1

ELECTRICAL DATA (cont'd.)

Ratings and Normal Operations	MIL–E–1 Symbol	Test Limit or Absol. Min.	Normal Test Cond.	Normal Operation	Test Limit or Absol. Max.	MIL–E–1 Units
TESTS (cont'd)						
Pulse Cathode Current (1) (Notes B, C) Eb = 150 Vdc; Ef = 5.7V; egk = +50V; Rg = 47 ohms max.; Rp = 0	ik:	400	---	---	---	ma
Pulse ib/ic2(1) Eb = 150 Vdc; (Notes B,C) egk=+50 V Rg = 47 ohms max.; Rp = 0	----	2.5	---	3.5	---	---
Pulse Cathode Current (2) (Notes B, C) Eb = 150 Vdc; egk = 50V; Rp = 0; RL = 0 Rg = 47 ohms max.	ik:	500	---	750	---	mA
Pulse Cathode Current (3) (Notes B, C) eb = egk = +50V; Ec_1 = −10 Vdc; Rg = Rp = 0	ik:	370	---	---	---	mA
Capacitance: no shield (Note B)	Cgp:	1.2	---	1.5	1.8	pf
Capacitance: no shield (Note B)	Cin:	1.4	---	1.9	2.4	pf
Capacitance: no shield Section No. 1	Cout:	0.20	---	0.28	0.36	pf
Capacitance: no shield Section No. 2	Cout:	0.22	---	0.32	0.42	pf
Capacitance: no shield	Cgg:	---	---	---	0.011	pf
Capacitance: no shield	Cpp:	---	---	---	0.50	pf

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests:

Shock Test –	735 G. 49° hammer angle in Navy High Impact Shock machine. Sample subjected to twenty (20) impact accelerations, five impact accelerations in each of four different positions.
Fatigue Test –	10 G. Sample subjected to vibrational acceleration of 10 G for 6 hours (2 hours in each of three positions). The frequency of vibration is varied from 30 cps to 3000 cps and back to 30 cps.
Glass Strain –	A sample is subjected to a forty-eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.
Heater Cycling – Life Test	A sample is subjected to 2000 1 min. on, 4 min. off heater cycles at the following conditions: Ef = 7.0 volts; Ehk = 140 Vac and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits or heater to cathode shorts.
Grid Pulse – Life Test 500 Hours	Sample is operated with Ef = 6.3; Eb= 250V; Ec_1 = −30 Vdc; egk = +50 v; Rp/p = 180 ohms; Rg/g = 47 ohms max. T Envelope = 150°C for 500 hrs.

APPLICATION NOTES

A. The maximum rating for epy applies only to the spike occurring at the leading edge of the pulse waveform. The spike duration must be limited to 0.1 tp. (See Figure 31, paragraph 4.10.7.5 of MIL–E–1.)

B. Test each section separately.

C. The tube shall be operated in a pulse circuit as follows: tp = 10 μsec; (between 80% amplitude points) prr = 100 pps; tr = 1.0 μsec Max. (between 10% and 80% amplitude points); tf = 1.0 μsec Max. (between 80% and 10% amplitude points):

APPLICATION NOTES (cont'd)

Measure peak current across a 1.0 ohm ±0.1% resistor in the specified circuit.

Prior to testing preheat tubes with Ef = Test Volts the only applied voltage for a minimum of five minutes. After insertion into the test socket, each tube must be permitted to stabilize for one minute minimum at pulse conditions.

DIFFICULTIES MAY BE ENCOUNTERED WHEN ATTEMPTING TO MAKE ACCURATE MEASUREMENTS OF PULSE CURRENTS. IT IS RECOMMENDED THAT THE TEST PROCEDURES AND TECHNIQUES BE DISCUSSED WITH THE TUBE MANUFACTURER.

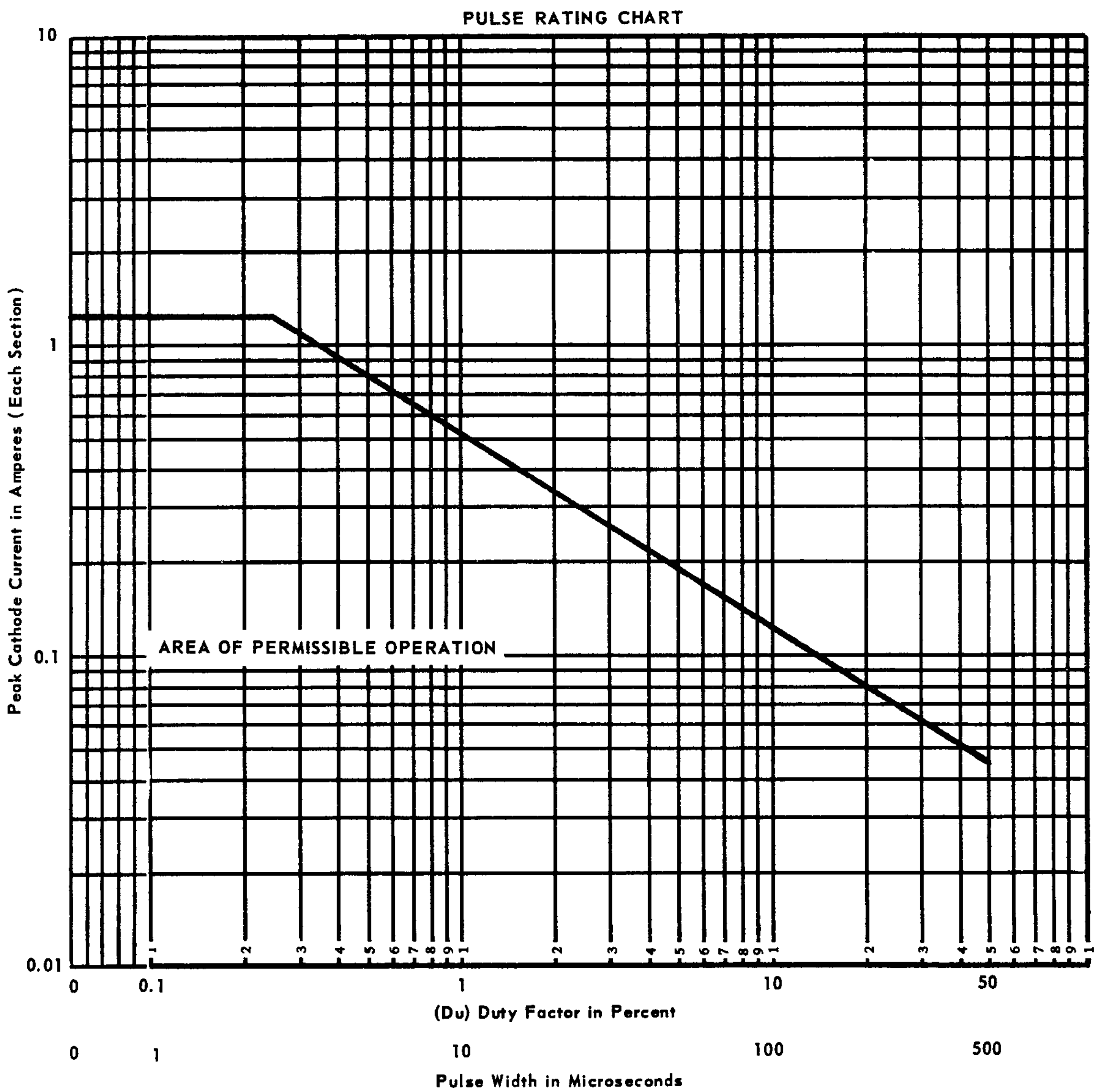
D. eb is defined as the peak voltage between plate and cathode (non-conducting).

DISCUSSION AND EXPLANATION OF PULSE RATING CHART

The following chart is applicable for operation where the duty factor does not exceed 50 per cent and the pulse width does not exceed 500 micro seconds. It is believed that these ranges include well over 90 per cent of pulse applications, and applications beyond these limits should be referred to Raytheon Field Engineering.

The area under the heavy boundary line is the area of "permissible operation", provided that other parameters are maintained within their absolute maximum values. The maximum permissible peak cathode current is limited by both duty factor (Du) and Pulse Width (tp), and for a given application is determined as the lower peak current obtained by the intersection with the bondary line of either the Du or tp coordinates. Within these limitations normal life performance may be expected. During manufacture control life tests are performed under operating conditions which yield peak currents exceeding those permitted by the chart, thus assuring satisfactory life when the tube is operated within the area of permissible operation.

APPLICATION NOTES (cont'd)



CAUTION --- To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

ACCEPTANCE CRITERIA

The following tests shall be performed.

For the purpose of inspection, use applicable reliable paragraphs of Spec. MIL–E–1.

For misc. requirements, see 3.6.

Test Conditions:

Heater Voltage 6.3 V
Plate Voltage 150 Vdc
Grid Voltage −30 Vdc

MIL–E–1 Ref.	Test	AQL (%)	Level or Code	Max. LTPD % (Note 1)	Min. Sample Size	Symbol	LIMITS Min.	Bogey	Max.	Units
	MEASUREMENTS ACCEPTANCE TESTS									
4.10.8	Heater Current	0.65	II	4.4	Code L	If	280	300	320	mA
4.10.15	Heater-Cathode Leakage: Note 3 Ehk = ± 100 Vdc	0.65	II	4.4	Code L	Ihk	---	---	5.0	μAdc
4.10.6.1	Grid Current: Note 3 Eb = 100 Vdc; Ec = 0; Rk = 220 ohms	0.65	II	4.4	Code L	Ic_1	0	---	−0.5	μAdc
4.10.4.1	Plate Current: Note 3 Eb = 300 Vdc; Ec = −32 Vdc; Rk = 0	0.65	II	4.4	Code L	Ib	---	---	10	μAdc
4.10.7.5	Pulse Cathode Current (1): Notes 3 and 5 Ef = 5.7V; egk = +50v; Rg = 47 ohms Max.; Rp = 0	2.5	I	13.0	Code I	ik	400	---	---	ma
·······	Pulse ib/icl (1): Notes 3, 5 egk = +50v; Rg = 47 ohms Max.; Rp = 0	6.5	I	22.0	Code I	---	2.5	3.5	---	
4.10.7.5	Pulse Cathode Current (2): Notes 3 and 5 egk = +50 v; RL = 0; Rg = 47 ohms Max.; Rp = 0	0.65	II	4.4	Code L	ik	500	750	---	ma
·······	Pulse Cathode Current (3): Notes 3 and 5 eb = egk = +50 v; Ecl = −10 Vdc; Rg = Rp = 0	6.5	I	22.0	Code I	ik	370	---	---	ma
·······	Continuity and Shorts: Note 2	0.4	II	3.5	Code L	---	---	---	---	
4.9.1	Mechanical: Envelope (8-1)	---	---	---	---	---	---	---	---	
4.8.2	Insulation of Electrodes: Note 3	2.5	L6	12.8	Code H		---	---	---	
	Eg = all = −100 Vdc					R(g−all)	100	---	---	Meg
	Ep = all = −300 Vdc					R(p−all)	100	---	---	Meg
4.10.14	Capacitance: No Shield	6.5	Code E	---	---	---	---	---	---	
	Cgp Note 3	---		---	---	Cgp	1.2	1.5	1.8	pf
	Cin Note 3	---		---	---	Cin	1.4	1.9	2.4	pf
	Cout Section No. 1	---		---	---	Cout	0.20	0.28	0.36	pf
	Section No. 2	---		---	---	Cout	0.22	0.32	0.42	pf
	Cgg	---		---	---	Cgg	---	---	0.011	pf
	Cpp	---		---	---	Cpp	---	---	0.50	pf
4.9.12.1	Low Pressure Voltage Breakdown: Note 6 Pressure = 21 ± 2 mm Hg; Voltage = 300 Vac	6.5	L6	25.0	Code G	---	---	---	---	
·······	White Noise: Notes 3 and 7 Eb = 100 Vdc; Rp = 10,000 Ohms; Rk = 220 ohms; Cg = 1000 μf	1.0	I	7.7	Code I	---	---	---	200 30	mV pk-pk mVac

MIL-E-1 Ref.	Test	AQL (%)	Level or Code	Max. LTPD % (Note 1)	Min. Sample Size	Symbol	LIMITS Min.	Bogey	Max.	Units
DEGRADATION RATE ACCEPTANCE TESTS: Note 4										
4.9.5.3	Subminiature Lead Fatigue	2.5	L6	12.8	Code H	---	4	---	---	Arcs
4.9.20.5	Shock: Note 8 Hammer Angle = 49° Eb = 100 Vdc; Ehk = +100 Vdc; Rg = 0.1 Meg	20	---	---	---	---	---	---	---	
4.9.20.6	Fatigue: Notes 6 and 9 Eb = 100 Vdc; Ec = -2.0 Vdc; Rk = 0; G = 10; Variable Frequency	6.5	L6	25.0	Code G	---	---	---	---	
-------	Post Shock and Fatigue Test End Points: White Noise	---	---	---	---	---	---	---	300 45	Mv pk-pk mVac
	Heater-Cathode Leakage Ehk = ± 100 Vdc	---	---	---	---	Ihk	---	---	20	µAdc
	Change in Pulse Cathode Current (2) of Individual Tubes	---	---	---	---	$\Delta_t$ik	---	---	15	%
4.9.6.3	Glass Strain:	6.5	I	22.0	Code I	---	---	---	---	

MIL-E-1 Ref.	Test		Symbol	LIMITS Min.	Max.	Units
ACCEPTANCE LIFE TFSTS: Note 4						
4.11.7	Heater Cycling Life Test: Note 10 Ef = 7.0V; 1 min. on, 4 min. off; Ehk = 140 Vac; Eb = Ec = 0V		---	---	---	
-------	Grid Pulse Life Test: Notes 5 and 11; Ef = 6.3V; Eb = 250 Vdc; egk = +50 v; Ecl = -30 Vdc; Rp/p = 180 ohms; Rg/g = 47 ohms Max.; T-Envelope = 150°C		---	---	---	
-------	Grid Pulse Life Test End Points					
	Inoperatives		---	---	---	
	Grid Current		Ic	---	-1.0	µAdc
	Change of Pulse Cathode Current of Individual Tubes		Δik	---	-25 +50	%
	Heater-Cathode Leakage +Ihk		Ihk	---	10	µAdc
	Total Defectives		---	---	---	

ACCEPTANCE CRITERIA NOTES:

Note 1: The maximum LTPD (Lot Tolerance Percent Defective) is defined as the percent defective in the lot for which the probability of acceptance is 10%.

Note 2: Per MIL-E-1 ref. 4.7.

Note 3: Test each section separately.

Note 4: Destructive Tests: Tubes subjected to the following destructive tests are not to be accepted under this specification:

4.9.20.5	Shock
4.9.20.6	Fatigue
4.11.7	Heater Cycling Life Test
4.9.5.3	Lead Fatigue
-------	Grid Pulse Life Test

Note 5: The tube shall be operated in a pulse circuit as follows: tp = 10 μsec (between 80% amplitude points); prr = 100 pps; tr = 1.0 μsec Max. (between 10% and 80% amplitude points); tf = 1.0 μsec Max. (between 80% and 10% amplitude points):

Measure peak current across a 1.0 ohm ± 0.1% resistor in the specified circuit.

Prior to testing, preheat tubes with Ef= Test Volts, the only applied voltage, for a minimum of five minutes. After insertion into the test socket, each tube must be permitted to stabilize for one minute minimum at pulse conditions.

DIFFICULTIES MAY BE ENCOUNTERED WHEN ATTEMPTING TO MAKE ACCURATE MEASUREMENTS OF PULSE CURRENTS. IT IS RECOMMENDED THAT THE TEST PROCEDURES AND TECHNIQUES BE DISCUSSED WITH THE TUBE MANUFACTURER.

Note 6: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. In the event of lot failure, the lot shall be rejected and the succeeding lot shall be subjected to this test. Once a lot has passed, the 30 day rule shall apply.

Note 7: The tube shall be rigidly mounted on a table vibrating such that the instantaneous values of acceleration shall constitute approximately a "White Noise" spectrum which is free from discontinuities from 100 to 5000 cps and such that the RMS value of acceleration for frequencies outside this band shall constitute no more than five percent of the total RMS acceleration. The spectrum of instantaneous acceleration shall be such that each octave of bandwith delivers 2.3 ± 0.2 G's RMS acceleration. With this the case, the RMS value of acceleration for any bandwidth within the specified spectrum is equal to

$$G_{rms} = 2.3 \sqrt{3.32 \log_{10} (f2/f1)}$$

where f2 and f1 are the upper and lower frequencies respectively of the band under consideration. The degree of clipping of the peak accelerations shall be such that the peak value of acceleration is at least 15 G's.

Half the tubes in each sample shall be vibrated in position X1, the other half in position X2.

The voltage (ep) produced across the resistor (Rp) as a result of vibration shall be coupled through a compensating amplifier to a low pass filter. The compensating amplifier shall have a high input impendance (250 Kohms or more) and shall be adjusted to compensate for any insertion losses in the filer. The combined frequency response of amplifier shall be flat within ± 0.5 db from 50 to 8000 cps, shall be down no more than 5 db at 10,000 cps and at 20 cps, and down at least 30 db at 13,000 cps. For reading the peak to peak value of output voltage, the filter output shall be fed directly to the input of a Ballantine Model 305 peak to peak electronic voltmeter or equal, while the RMS value shall be measured with a Hewlett-Packard Model 400 C or equal. The impedance of the plate and screen voltage supplies shall not exceed that of a 40 μf capacitor at 10 cps.

Note 8: A grid resistor of 0.1 megohm shall be added; however, this resistor shall not be used when a thyratron - type short indicator is employed.

Note 9: The tubes shall be rigidly mounted on a table vibrating at a constant acceleration level of 10G. The frequency of vibration shall be varied from 30 cps to 3000 cps and back to 30 cps with three minutes being the time required to sweep the range in each direction. The rate of change of frequency with time shall be such that the frequency varies logarithmically with time. The tubes shall be vibrated for a total of six hours, that is two hours in each of the three positions X1, X2 and Y1. Heater voltage only shall be applied to the tube under test.

Note 10: The no-load to steady state full load regulation of the heater voltage supply shall not be more than 3.0%. This test shall be made on a lot-by-lot basis. A failure or defect shall consist of an open heater, open cathode circuit or a heater-cathode short.

Note 11: Grid Pulse Life Test shall be conducted for 500 hours with interim readings of Pulse Cathode Current end point made at zero; 20 plus or minus 4 hours and 200 (+48, −24) hours. Readings of Ic1 and Ihk shall be made at zero (0) hours and at the completion of the life test.

Change of Pulse Cathode Current shall be calculated as the percentage change from zero hours to each reading period.

Life test shall be conducted under a double sampling plan of which the first sample shall consist of 20 tubes. If a tube is defective for more than one characteristic, the characteristic appearing first in the life-test end points shall constitute the failure.

AVERAGE PLATE CHARACTERISTICS

